

CLAIMS

1. A wastewater treatment agent produced by mixing a first flocculant that is a high-molecular-weight substance and a second flocculant that is a low-molecular-weight substance, the wastewater treatment agent acting by flocculating surfactant components 5 present in wastewater.

2. A wastewater treatment agent as claimed in claim 1, wherein the first flocculant is polyaluminum chloride and the second flocculant is aluminum chloride.

10 3. A wastewater treatment agent as claimed in claim 2, wherein the polyaluminum chloride and the aluminum chloride are mixed in a ratio of 4 : 1 to 6 : 1 by weight on an aluminum oxide basis.

15 4. A polluted water purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a flocculant, comprising:

a mixer for mixing the polluted water with the flocculant and air;
an agitator for agitating the polluted water, containing the flocculant and the air, that flows into a cylindrical agitation chamber along an inner surface thereof by making the 20 polluted water into a spiraling stream so that flocks formed by the flocculant hold bubbles; and

a separator, connected to the agitator, for temporarily storing the polluted water and for separating the flocks holding the bubbles.

SEARCHED
INDEXED
MAILED

5. A polluted water purifier as claimed in claim 4,
wherein the mixer has an aspirator for sucking in the flocculant and the air under a
reduced pressure.

5 6. A polluted water purifier as claimed in claim 4,
wherein the agitation chamber is arranged upright and has a cylindrical mixing
cylinder provided inside, and the polluted water, containing the flocculant and the air, first
flows up as the spiraling stream along the inner surface of the agitation chamber and then
flows down inside the mixing cylinder.

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7. A polluted water purifier as claimed in claim 6,
wherein the mixing cylinder has a spiral fin composed of a plurality of serially
coupled substantially rectangular plate-shaped members each having opposite sides thereof
twisted at a predetermined angle.

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8. A polluted water purifier as claimed in claim 6,
wherein the separator is formed integrally with and fitted detachably to the agitation
chamber.

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9. A polluted water purifier as claimed in claim 4,
wherein the separator has a reservoir section for temporarily storing the polluted water
and discharging the polluted water from a topmost section thereof and a filter section for
filtering out the flocks contained in the polluted water that has flowed out of the reservoir
section.

SEARCHED
INDEXED
SERIALIZED
FILED

10. A polluted water purifier as claimed in claim 9,
wherein the reservoir section is arranged inside the filter section.

5 11. A polluted water purifier as claimed in claim 9,
wherein the filter section collects the flocks with a collecting member composed of a
washing net.

10 12. A polluted water purifier as claimed in claim 4,
wherein a member arranged in a path of the polluted water has an inner wall thereof
treated with non-cohesion treatment.

15 13. A polluted water purifier for collecting a pollutant present in polluted water by
flocculating the pollutant with a flocculant, comprising:
a polluted water tank for storing the polluted water;
a first mixer for mixing the polluted water with the flocculant to produce primary
flocks,
a second mixer for mixing the polluted water containing the primary flocks with the
flocculant and air;
20 an agitator for agitating the polluted water containing the flocculant and the air so as to
make the primary flocks hold bubbles and thereby produce secondary flocks; and
a separator for separating the secondary flocks,
wherein the polluted water tank, the first mixer, the second mixer, the agitator, and the
separator are coupled in this order to form a circulation path that leads back to the polluted

water tank.

14. A polluted water purifier as claimed in claim 13,

wherein the first mixer has an aspirator for sucking in the flocculant, a first adder for
5 adding the flocculant in a predetermined amount, and a first agitating chamber, cylindrical in
shape, for agitating the polluted water containing the flocculant by making the polluted water
into a spiraling stream.

15. A polluted water purifier as claimed in claim 14,

10 wherein the first adder controls the amount in which the flocculant is added according
to concentration, turbidity, or a pH value of the polluted water.

16. A polluted water purifier as claimed in claim 13,

wherein the second mixer has an aspirator for sucking in the flocculant to mix the
15 flocculant with the polluted water containing the flocks, a second adder for adding the
flocculant in a predetermined amount, and a sucker for sucking in the air.

17. A polluted water purifier as claimed in claim 16,

wherein the second adder controls the amount in which the flocculant is added
20 according to concentration, turbidity, or a pH value of the polluted water.

18. A polluted water purifier as claimed in claim 13,

wherein the agitator is provided with a second agitation chamber cylindrical in shape
and arranged upright and a mixing cylinder cylindrical in shape and arranged inside the

second agitation chamber, and the polluted water, containing the flocculant and the air, first flows up as a spiraling stream along an inner surface of the second agitation chamber and then flows down inside the mixing cylinder.

5 19. A polluted water purifier as claimed in claim 18

 wherein the mixing cylinder has a spiral fin composed of a plurality of serially coupled substantially rectangular plate-shaped members each having opposite sides thereof twisted at a predetermined angle.

10 20. A polluted water purifier as claimed in claim 19,

 wherein the separator has a reservoir section for storing the polluted water and a bag-shaped net, arranged inside the reservoir section, for collecting the secondary flocks as the secondary flocks float on the polluted water.

15 21. A polluted water purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a flocculant, comprising:

 an aspirator for sucking in the flocculant and air to mix the flocculant and the air with the polluted water and thereby produce flocks holding bubbles; and

 a separator for separating the flocks holding the bubbles from the polluted water.

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 22. A polluted water purifier as claimed in claim 21,

 wherein the flocculant is a solution of polyaluminum chloride or aluminum chloride in water.

23. A polluted water purifier as claimed in claim 21,
wherein the flocculant is a mixture of an inorganic flocculant and a polymer flocculant
or a solution of the mixture in water.

5 24. A polluted water purifier as claimed in claim 21,
wherein an auxiliary aspirator for sucking in the flocculant and mixing the flocculant
with the polluted water is provided on an upstream side of the aspirator, the auxiliary aspirator
being supplied with the inorganic flocculant, the aspirator being supplied with the polymer
flocculant.

10 25. A polluted water purifier as claimed in claim 24,
wherein the aspirator is given a higher degree of vacuum than the auxiliary aspirator.

15 26. A polluted water purifier as claimed in claim 21,
wherein a mixing bath for mixing the flocculant with the polluted water is provided on
an upstream side of the aspirator.

20 27. A polluted water purifier as claimed in claim 21,
wherein the flocculant is supplied to the aspirator after being diluted according to
concentration of the pollutant contained in the polluted water.

28. A polluted water purifier as claimed in claim 21,
wherein the aspirator has a downstream-side portion thereof divided into a plurality of
parts.

29. A polluted water purifier as claimed in claim 21,
wherein the separator is a filtering device filled with a granular filtering material.

5 30. A polluted water purifier as claimed in claim 21,
wherein the separator separates the flocks from the polluted water by letting the flocks
holding the bubbles float on the polluted water.

10 31. A polluted water purifier as claimed in claim 21,
wherein the separator has an inner layer portion formed substantially in a shape of a
truncated cone whose diameter decreases from bottom to top, an inlet through which the
polluted water is taken into a lower portion of the inner layer portion along an inner wall
thereof, an inner pipe whose top end is located close to a ceiling surface of the inner layer
portion and whose bottom end penetrates a floor surface of the inner layer portion, an outer
15 layer portion covering the inner layer portion and communicating with the inner layer portion
through a large number of small holes formed in an upper portion of a peripheral wall of the
inner layer portion, and an outlet through which the polluted water having the flocks filtered
out by the small holes is drained, as purified water, out of the outer layer portion.

20 32. A polluted water purifier as claimed in claim 21,
wherein the separator has a rotatable cylindrical filter, which collects the flocks from
the polluted water flowing into the filter by centrifugal force and which then discharges the
polluted water cleared of the flocks through a peripheral surface of the filter.

33. A polluted water purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a flocculant, comprising:

a pH value controller for lowering a pH value of the polluted water by adding an acid to the polluted water.

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34. A polluted water purifier as claimed in claim 33, wherein the pollutant is an anionic surfactant and is present in the polluted water in a concentration of 400 ppm or lower.

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35. A polluted water purifier as claimed in claim 34, wherein the flocculant is a cationic inorganic flocculant.

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36. A polluted water purifier as claimed in claim 33, wherein the polluted water flowing out of the pH controller has a pH value of 3 to 6.

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37. A washing machine incorporating a purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a flocculant, comprising:

an aspirator for sucking in the flocculant and air to mix the flocculant and the air with the polluted water and thereby produce flocks holding bubbles; and

a separator for separating the flocks holding the bubbles from the polluted water.

38. A washing machine incorporating a purifier as claimed in claim 37, wherein a motor for driving a washing tub or a pulsator arranged inside a washing tub to rotate is provided, and the separator has a cylindrical filter that is driven by the motor to

rotate, the filter collecting the flocks from the polluted water flowing into the filter by centrifugal force and then discharging the polluted water cleared of the flocks through a peripheral surface of the filter.

5 39. A washing machine incorporating a purifier, comprising a water tub having a shape of a bottomed cylinder and a polluted water purifier that collects a pollutant present in washing wastewater by flocculating the pollutant to produce flocks and then separating the flocks by filtering the flocks out with a separator,

wherein the separator is fitted detachably to the water tub.

10 40. A washing machine incorporating a purifier as claimed in claim 39,
wherein the separator is fitted at an opening of the water tub.

15 41. A washing machine incorporating a purifier as claimed in claim 40,
wherein the separator is formed out of a same member as a tub cover for preventing
washing water from splashing over a rim of the water tub.

20 42. A washing machine incorporating a purifier as claimed in claim 40,
wherein a recess is formed substantially at a center of the separator.

25 43. A washing machine incorporating a purifier as claimed in claim 39,
wherein a rotatable washing tub is provided inside the water tub, and a flow of air
produced as the washing tub is rotated is kept in contact with the separator.

44. A washing machine incorporating a purifier as claimed in claim 43,
wherein the separator is so formed as to protrude into the washing tub.

5 45. A washing machine incorporating a purifier as claimed in claim 39,
wherein an attachment detector for detecting attachment of the separator is provided
so that operation of the washing machine is controlled according to a result of detection by the
attachment detector.

10 46. A washing machine incorporating a purifier as claimed in claim 39, further
comprising:
a flock detector for detecting an amount of the flocks collected in the separator; and
alerting means for giving an alert according to a result of detection by the flock
detector.

15 47. A washing machine incorporating a purifier, comprising a water tub having a
shape of a bottomed cylinder and a polluted water purifier that collects a pollutant present in
washing wastewater by flocculating the pollutant to produce flocks and then separating the
flocks by filtering the flocks out with a separator,
wherein the separator is fitted detachably so as to cover the water tub from above an
20 opening thereof.

48. A washing machine incorporating a purifier as claimed in claim 47,
wherein a door is provided above the opening of the water tub, and the separator can
be fitted to the door.

49. A washing machine incorporating a purifier comprising a polluted water purifier for purifying polluted water drained from a washing tub by removing a pollutant present in the polluted water,

5 wherein, halfway through a washing process, washing water is circulated from the washing tub through the polluted water purifier back to the washing tub.

50. A washing machine incorporating a purifier as claimed in claim 49,

10 wherein an outer tub is provided so as to enclose the washing tub, and the washing water flows from inside the washing tub to a space between the washing tub and the outer tub so as to be purified by the polluted water purifier, with the washing water prevented from flowing from the space between the washing tub and the outer tub back into the washing tub.

51. A washing machine incorporating a purifier as claimed in claim 50,

15 wherein the washing tub has increasing internal diameters toward an open end thereof.

52. A washing machine incorporating a purifier as claimed in claim 51,

wherein an amount of washing water discharged from the washing tub is varied by controlling rotation of the washing tub.

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53. A washing machine incorporating a purifier as claimed in claim 52

wherein, while the washing water is circulated, the washing tub repeats a cycle of forward rotation, sudden stop, reverse rotation, and sudden stop.

54. A washing machine incorporating a purifier as claimed in claim 49
wherein the washing water that has flowed into the space between the washing tub and
the outer tub is agitated by the washing tub as the washing tub is rotated.

5 55. A washing machine incorporating a purifier as claimed in claim 49,
wherein the washing water that returns to the washing tub is poured substantially onto
a central portion of the washing tub.

10 56. A washing machine incorporating a purifier as claimed in claim 49,
wherein, after the washing water stops being circulated, final rinsing is performed with
tap water.

15 57. A washing machine incorporating a purifier as claimed in claim 49,
wherein the polluted water purifier flocculates the pollutant with a flocculant to
produce flocks and then collects the flocks.

58. A washing machine incorporating a purifier and provided with a washing
process for removing dirt on laundry with washing water containing a detergent and a first
rinsing process for removing the detergent from the laundry, comprising:
20 a reservoir section for storing the drained washing water; and
a polluted water purifier for purifying the washing water by collecting a pollutant
present in the washing water stored in the reservoir section by flocculating the pollutant,
wherein the washing water used in the washing process and rinsing water used in the
first rinsing process is stored together in the reservoir section and is purified simultaneously

by the polluted water purifier.

59. A washing machine incorporating a purifier as claimed in claim 58,
wherein the polluted water purifier first flocculates the pollutant with an inorganic
5 flocculant and then flocculates again the flocculated pollutant by adding a polymer flocculant
thereto.

60. A washing machine incorporating a purifier as claimed in claim 58,
wherein a second rinsing process for performing rinsing with purified water obtained
10 from the polluted water purifier is further provided.

61. A washing machine incorporating a purifier as claimed in claim 60,
wherein a third rinsing process for performing, after the second rinsing process,
rinsing with tap water is further provided.

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62. A washing machine incorporating a purifier as claimed in claim 58, further
comprising:

a washing tub that is rotatably supported and in which the laundry is put; and
an outer tub enclosing the washing tub,
20 wherein a space between the washing tub and the outer tub constitutes the reservoir
section.

63. A washing machine incorporating a purifier and provided with a washing
process for removing dirt on laundry with washing water containing a detergent and a first

rinsing process for removing the detergent from the laundry, comprising:

a reservoir section for storing the drained washing water; and

a polluted water purifier for purifying the washing water by collecting a pollutant present in the washing water stored in the reservoir section by flocculating the pollutant,

5 wherein the washing water used in the washing process is purified by the polluted water purifier and is then used in the first rinsing process, and then rising water used in the first rinsing process is purified by the polluted water purifier.

64. A washing machine incorporating a purifier as claimed in claim 63,

10 wherein the rinsing water used in the first rinsing process and the washing water used in the washing process and then purified is stored together in the reservoir section and is purified simultaneously by the polluted water purifier.

65. A washing machine incorporating a purifier, comprising a polluted water purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a flocculant,

wherein the polluted water purifier comprises:

a mixer for mixing the polluted water with the flocculant and air;

an agitator for agitating the polluted water, containing the flocculant and the air,

20 that flows into a cylindrical agitation chamber along an inner surface thereof by making the polluted water into a spiraling stream so that flocks formed by the flocculant hold bubbles; and

a separator, connected to the agitator, for temporarily storing the polluted water and for separating the flocks holding the bubbles.

66. A washing machine incorporating a purifier as claimed in claim 65, wherein the mixer has an aspirator for sucking in the flocculant and the air under a reduced pressure.

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67. A washing machine incorporating a purifier as claimed in claim 65,
wherein the agitation chamber is arranged upright and has a cylindrical mixing
cylinder provided inside, and the polluted water, containing the flocculant and the air, first
flows up as the spiraling stream along the inner surface of the agitation chamber and then
10 flows down inside the mixing cylinder.

68. A washing machine incorporating a purifier as claimed in claim 67,
wherein the mixing cylinder has a spiral fin composed of a plurality of serially
coupled substantially rectangular plate-shaped members each having opposite sides thereof
15 twisted at a predetermined angle.

69. A washing machine incorporating a purifier as claimed in claim 67, wherein the separator is formed integrally with and fitted detachably to the agitation chamber.

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70. A washing machine incorporating a purifier as claimed in claim 65, wherein the separator has a reservoir section for temporarily storing the polluted water and discharging the polluted water from a topmost section thereof and a filter section for filtering out the flocks contained in the polluted water that has flowed out of the reservoir

section.

71. A washing machine incorporating a purifier as claimed in claim 70,
wherein the reservoir section is arranged inside the filter section.

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72. A washing machine incorporating a purifier as claimed in claim 70,
wherein the filter section collects the flocks with a collecting member composed of a
washing net.

10 73. A washing machine incorporating a purifier as claimed in claim 65,
wherein a member arranged in a path of the polluted water has an inner wall thereof
treated with non-cohesion treatment.

15 74. A washing machine incorporating a purifier, comprising a polluted water
purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a
flocculant,

wherein the polluted water purifier comprises:

20 a polluted water tank for storing the polluted water;
a first mixer for mixing the polluted water with the flocculant to produce
primary flocks,
a second mixer for mixing the polluted water containing the primary flocks
with the flocculant and air;
an agitator for agitating the polluted water containing the flocculant and the air
so as to make the primary flocks hold bubbles and thereby produce secondary flocks; and

SEARCHED
INDEXED
MAILED
FILED

a separator for separating the secondary flocks,
wherein the polluted water tank, the first mixer, the second mixer, the agitator, and the separator are coupled in this order to form a circulation path that leads back to the polluted water tank.

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75. A washing machine incorporating a purifier as claimed in claim 74,
wherein the first mixer has an aspirator for sucking in the flocculant, a first adder for adding the flocculant in a predetermined amount, and a first agitating chamber, cylindrical in shape, for agitating the polluted water containing the flocculant by making the polluted water 10 into a spiraling stream.

76. A washing machine incorporating a purifier as claimed in claim 75,
wherein the first adder controls the amount in which the flocculant is added according to concentration, turbidity, or a pH value of the polluted water.

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77. A washing machine incorporating a purifier as claimed in claim 74,
wherein the second mixer has an aspirator for sucking in the flocculant to mix the flocculant with the polluted water containing the flocks, a second adder for adding the flocculant in a predetermined amount, and a sucker for sucking in the air.

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78. A washing machine incorporating a purifier as claimed in claim 77,
wherein the second adder controls the amount in which the flocculant is added according to concentration, turbidity, or a pH value of the polluted water.

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79. A washing machine incorporating a purifier as claimed in claim 74,
wherein the agitator is provided with a second agitation chamber cylindrical in shape
and arranged upright and a mixing cylinder cylindrical in shape and arranged inside the
second agitation chamber, and the polluted water, containing the flocculant and the air, first
5 flows up as a spiraling stream along an inner surface of the second agitation chamber and then
flows down inside the mixing cylinder.

80. A washing machine incorporating a purifier as claimed in claim 79,
wherein the mixing cylinder has a spiral fin composed of a plurality of serially
10 coupled substantially rectangular plate-shaped members each having opposite sides thereof
twisted at a predetermined angle.

81. A washing machine incorporating a purifier as claimed in claim 80,
wherein the separator has a reservoir section for storing the polluted water and a bag-
15 shaped net, arranged inside the reservoir section, for collecting the secondary flocks as the
secondary flocks float on the polluted water.

82. A washing machine incorporating a purifier, comprising a polluted water
purifier for collecting a pollutant present in polluted water by flocculating the pollutant with a
20 flocculant,

wherein the polluted water purifier comprises:
a pH value controller for lowering a pH value of the polluted water by adding an acid
to the polluted water.

83. A washing machine incorporating a purifier as claimed in claim 82, wherein the pollutant is an anionic surfactant and is present in the polluted water in a concentration of 400 ppm or lower.

5 84. A washing machine incorporating a purifier as claimed in claim 83, wherein the flocculant is a cationic inorganic flocculant.

85. A washing machine incorporating a purifier as claimed in claim 82, wherein the polluted water flowing out of the pH controller has a pH value of 3 to 6.

10 86. A method of purifying polluted water by collecting a pollutant present in the polluted water by flocculating the pollutant with a flocculant, comprising a step of lowering a pH value of the polluted water by adding an acid to the polluted water.